MANUAL

OF

SALMON AND TROUT HATCHING,

OR AN EXPLANATION OF THE

FISH-HATCHING APPARATUS

IN THE

ROYAL HORTICULTURAL GARDENS,
THE SOUTH KENSINGTON MUSEUM,
ZOOLOGICAL GARDENS, &c., &c.

BY

FRANK BUCKLAND,
M.A., M.R.C.S., F.Z.S.,
Late Assistant-Surgeon 3rd Life Guards.

LONDON:
TINSLEY BROTHERS, 18, CATHERINE ST., STRAND.
1864.

Price Sixpence.

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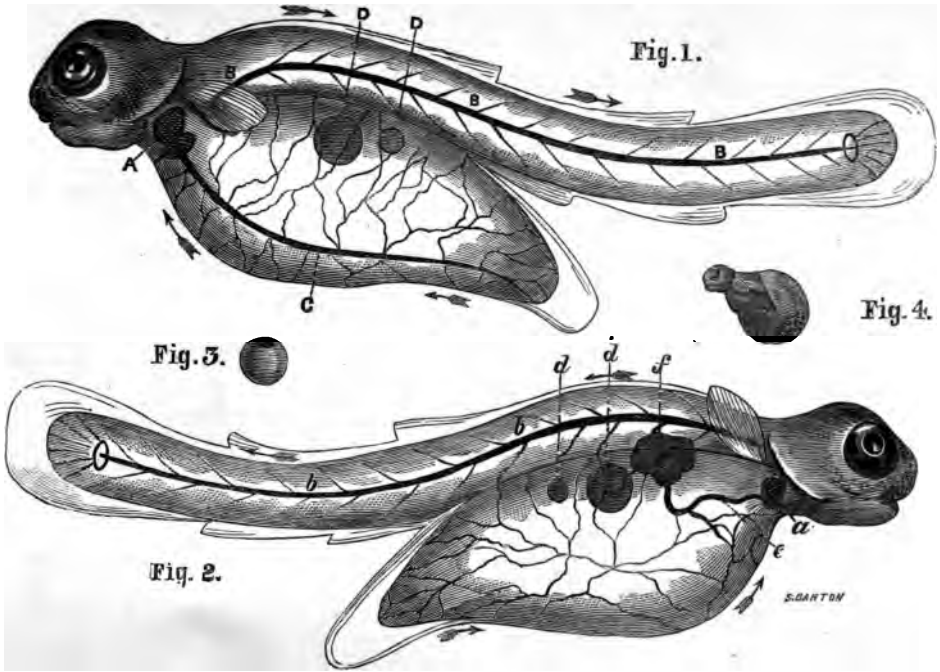

YOUNG SALMON, ABOUT A WEEK OLD.

EXPLANATION OF THE FIGURES.

FIG. 1

Shows the left side of the fish (magnified 120 *diameters).*

A. The heart.
B. Main trunk artery.
C. Large vein.
D. Oil globules, only two of which are introduced, for the sake of distinctness.

FIG. 2.

Showing the right side of the fish.

a. The heart.
b. Main-trunk artery.
c. The liver.
d. Oil globules.
e. Large vein from liver to heart.
f. Branch from main artery to liver.

FIG. 3.—Salmon Egg.
FIG. 4.—Young Salmon hatching out.

NOTE.—The bag attached to the fish contains the nourishment, which is gradually absorbed into its body. As the fish gets larger the bag gets smaller, and the fish does not feed till the bag is quite gone, which is about six weeks or two months after it is born.—*See pages* 22 & 28.

PREFACE.

THIS Manual will be found to contain a general explanation of hatching fish by artificial means, in order that those who examine the various apparatus under my management in London shall understand what is going on.

I am much indebted to my friend H. J. B. Hancock, Esq., for his kindness in superintending the drawing of the woodcut in the Manual, and also for his valuable assistance in other scientific matters.

Those who wish to see fish-hatching on a large scale, should pay a visit to the apparatus in the greenhouse of my good friend S. Ponder, Esq., of Elm Grove, Hampton

(about a mile from Hampton Court station). Mr. Ponder is always pleased to show the fish to visitors. Both Mr. Ponder and myself being the sub-committee of Pisciculture for the "Thames Angling Preservation Society," are endeavouring to do our best to re-stock the noble preserve of twenty-two miles in length in the river Thames, open to all anglers, with salmon and trout for the good of the public. I must here record my most sincere thanks to my friend, M. Coumes, chief Engineer of the French Fishing Establishment at Huningue, near Basle, for his kindness and liberality in sending me large consignments of the eggs of salmon, trout, &c., which (with the English fish) have been hatched out for public demonstration and instruction.

FRANK BUCKLAND.

MANUAL OR GENERAL OUTLINE

OF

SALMON AND TROUT HATCHING.

In the annals of progress there are few steps of greater interest than that of fish hatching. In this, man retains, and as it were takes under his control, those operations which, until lately, were performed under the sole guardianship of nature; and of which the results were left, surrounded by dangers of all kinds, to take their chance of arriving at maturity.

Fish hatching is beginning to take its place amongst the recognised sciences; and well it may, for it promises fair to become, before

many years, a source of national wealth, and certainly a great boon to the public at large. The more we consider, the more inexplicable does it appear, that during the number of years that man has existed on the earth, he has done so little towards cultivating the waters, although he has exercised, almost to the utmost, the dominion which was given him over the earth.

On land we have gamekeepers and watchers to spy out and destroy all enemies to our game beasts and birds; but in the water, where the fish live and breed, nobody looks after the water vermin. The "gamekeeper's" museum on the barn door is well stocked with weasels, hawks, and other vermin—"*pour encourager les autres;*" but where are your water shrimps, river tigers, &c., which ought by rights to meet with a like fate on the door of the boat-house?

Now, let us inquire what we lose by thus

neglecting the "treasures of the deep." It is well known that the increase of fish overweighs very largely that of animals living on land. Let us, for example, notice the highest oviparous animals, viz., the birds. They produce, in comparison to fish, but a *very* small number of eggs. For instance, the common fowl will produce about 120 eggs per annum. Compare this with the following table, and mark the difference :—

Salmon	weighing	20	lb	produces	20,000 eggs.
Trout	,,	1	,,	,,	1,008 ,,
Jack	,,	4½	,,	,,	42,840 ,,
Perch	,,	½	,,	,,	20,592 ,,
Roach	,,	¾	,,	,,	480,480 ,,
Smelt	,,	2	oz.	,,	36,652 ,,
Lump fish	,,	2	lb.	,,	116,640 ,,
Brill	,,	4	,,	,,	239,775 ,,
Sole	,,	1	,,	,,	134,466 ,,
Herring	,,	½	,,	,,	19,840 ,,
Mackerel	,,	1	,,	,,	86,120 ,,
Turbot	,,	8	,,	,,	385,200 ,,
Cod	,,	20	,,	,,	4,872,000 ,,

Trout and Salmon, on an average, carry

1000 eggs to each pound weight; but this does not apply to trout under one pound.

Again, T. C. Eyton, Esq., F.L.S., &c., gives the number of young in the shell of the oyster at spawning time as 1,800,000! Think of this, you who are paying 10*d.* a dozen for natives. Think what a mint of money you are consuming, when those twelve oysters may produce in the aggregate 21,600,000 young, value, at the same price as their parents, no less than £75,000! Cleopatra's pearl was surely nothing to this.

From eggs we naturally come to "nests." —"Fishes' Nests?" we hear a reader exclaim; "Oh, fishes do not build nests; how can they possibly do it?" To this, I merely answer, that fishes *do* make nests. I do not mean to say that in general they climb trees and build like birds, though the seven-spined stickle-back in salt, and the common stickle-

back in fresh water, make rather complicated nests. Most fish, indeed, do make shelters for their eggs, which are nests to all intents and purposes. When about to spawn, the Salmon and Trout select a shallow gravel bottom, the reason being that there shall be a more rapid flow of water, and hence a greater supply of oxygen to the eggs themselves, and also to the young ones when born. The nest is easily recognised, being a hillock or mound of gravel (about a wheelbarrow full), with a hollow sort of ditch in front of it, as though some one had been scraping it up with his heel. On removing the gravel to a depth of from one to two feet, the eggs appear all loose in it, like plums in a pudding. Seeing the delicate-looking ova, you naturally wonder how it is they are not crushed by the superincumbent gravel. So did I, until I found, by actual experiment, that single eggs were not

crushed until I placed a weight of five pounds six ounces upon them.

Mr. C. F. Walsh, of Dundee, gives an interesting account of the process of making the nest and depositing the eggs, which we here give *in extenso*. He says :—"I have seen hundreds of fish in the act of spawning. I have seen as many as thirty brace engaged in the operation at one time ; but I never saw the male fish take any part in the work ; the *fanning* up of the gravel is all done by the female. I say *fanning*, because I never saw any *boring* of the head into the ground. The female turns on her side, and by strong undulations drives up a cloud of gravel from her tail. How she contrives to remain on the same spot I cannot say ; but as they always spawn in a strong current, perhaps she uses only sufficient force to hold against the stream. Stones and gravel are easily moved under water, and therefore the

exertion necessary to throw up a bed of gravel is not great. To convince myself of this, I put some gravel into a trough of water, and holding a dead fish by the head and on its side, I gently undulated it, and I found the stones were puffed away as if by a gentle breeze of wind. I am aware that in all books on the subject, it is said that the male makes the ridd, but I am convinced there is no truth in this; the male fish 'wait on,' and their whole spare time appears to be occupied in 'pitching into' every other male fish within sight. They rush on open-mouthed, and generally turn on their side in striking; and by the time the business is over, they are much scratched and scarred. May not the injured state of the head be accounted for by their coming in contact with stones in their headlong assaults? I will mention one other thing I have observed. The female does *not* first

deposit her spawn, and then leave it to be impregnated by the male; the male cares nothing about the spawn, except to eat it. His object is to be with the female, for the protection of whom he will fight as long as he is able.

"The spawning process is carried on in this manner:—The female works away at the ridd, and after she has made a kind of trough she lies in it quite still; the male, who during the time she is working, is carying on a constant war, comes up, enters the trough, and assists the female in her efforts to deposit the spawn in the gravel-formed nest which she has heaped up. The male then drops astern. After a short time, the female again throws herself on her side and fans up the gravel, advancing the trough a little, and covering up the deposited spawn. This operation is repeated until both fish are exhausted.

"A great quantity of spawn is of course

wasted, being eaten by trout and other fish, which are always waiting about for the purpose. The exhaustion of the males is greater than that of the females; they die in numbers; the females do not die. You may pick up a great many exhausted and dead males, but seldom a female."—C. F. WALSH.

The chief reason why so many wounded and dead males are found, is because they fight so desperately with one another. In the artificial spawning process the males do not hurt each other, and therefore are not exposed to the same risks. For further particulars about spawning I would venture to refer the reader to my little work on "Fish Hatching," published by Tinsley Brothers, Catherine Street, Strand, price 5*s*.

After spawning, the ova undergo many vicissitudes, being liable to be carried away by floods, left high and dry by droughts, devoured as well by fresh-water shrimps,

river tigers, and various kinds of water fowl, as by fish of their own tribe, including, we regret to state, the parent fish. Yes, it is too true; it has been proved beyond power of doubt that both the father and mother will devour their own ova! The results are, taking the salmon for example, that, according to Messrs. Ashworth and Buist, *only one salmon's egg out of every thousand deposited by the parent fish ever becomes a fish fit for human food.* Other fish suffer in proportion, and so we have to pay—in the high prices which the fishmongers are obliged to charge—for our own improvidence in not taking means to preserve such a valuable commodity.

Now, the question is, how are we to proceed in order to prevent all this? And this I will endeavour to answer as concisely as possible. First, we must catch the female, and, to prevent her depositing her eggs in a natural nest, we must take them from her

in the manner described by myself in my book before mentioned, put them in an artificial nest, and provide for them an "artificial mother." The nest consists of gravel placed in a narrow trough, and the mother, of a stream of shallow water kept running night and day. The method of procedure is as follows:—We get a number of narrow boxes filled with gravel to within two inches of the top, and we arrange them one above the other like a flight of stairs; the water enters the uppermost box from a cistern, and flows through it into the next, from that to the third, and so on *ad libitum*. The ova are laid on the gravel, the troughs covered each with a piece of board to keep out the light and so prevent the accumulation of vegetation, *et voilà tout!* In about thirty-five or forty days you will see two black specks appear in the egg, which are the eyes of the future fish; and you will also see

a faint line running around nearly three-quarters of the egg,—the body of the future salmon or trout. When you see this you may be sure that the egg is alive, and will probably hatch out all right. At the proper temperature it requires thirty-five days for the eyes to appear (*i. e.* that the fish is formed in the egg), and they hatch out fourteen days afterwards.

There is one curious circumstance about which much uncertainty prevailed, but which I have satisfactorily ascertained, and that is, that the eggs do *not* grow, *i. e.* they do not increase in circumference or diameter; but the fish *inside* them most certainly increase in bulk, till at last they become so large that the egg-shells suddenly burst, and out come the young fish. The young fish has attached to the under part of its body a large bag, nearly the size of a lemon pip, but more oblong in shape, and in this bag, which is called the umbilical

vesicle, it carries all the food which is to last it until it begins to eat with its mouth. The form of this bag renders it occasionally very difficult for the little creatures to disengage themselves from the empty egg-shell; they get their heads and tails clear, but the "*res angusta domi*" won't allow of their taking their forage bag with them, and it is often necessary to lend them a helping hand to enable them to make a decent start in life. Occasionally too, from weakness, they are unable to disengage more than their heads, and there they stop with the egg-shell tight round their necks, staring at each other with their great eyes, like a lot of ploughboys ready to start in a sack race; there they stop until they die, or are assisted to come out. The average weight of a young salmon just hatched is nearly *two grains*, forage bag and all; he has therefore a good deal to make up before he is fit to lie in Mr. Groves'

window! The rate of increase of weight in the young salmon, according to my friend, Mr. Ashworth, is as follows:—

"At three days old he is nearly 2 grains in weight; at 16 months old, he has increased to 2 ounces, or 480 times its first weight; at 20 months old, after the smolt has been a few months in the sea, it becomes a grilse of 8½lbs, having increased 68 times in 3 or 4 months; at 2⅔ years old it becomes a salmon of 12 to 15lbs. weight; after which its increased rate of growth has not been ascertained, but by the time it becomes 30lbs. in weight it has increased 115,200 times the weight it was at first.

"I do not suppose there is any other animal that increases so rapidly, and at so little cost, and that becomes such a valuable article of food."

In the human subject the first part of the body to arrive at perfection is the lower

jaw, because it is required for the purpose of obtaining food. In the young salmon, however, there is no use for the jaw at first, for he is provided by nature with his bag of nourishment, as we have before mentioned; but he has numerous enemies, and not being in a condition to take his own part, must of necessity do his best to avoid them, and in order to do this, must see them,— consequently, his eyes are fully developed from the first, though the rest of his body is far from perfection.

It is curious to observe the cases of deformity which are found amongst young fish; though these, I must say, are the exception and not the rule. I beg here to quote my own words:—"Some of these fish have regular humped backs; others have their bodies twisted round their umbilical vesicle, córkscrew fashion: and when they see the spoon or the brush coming, or are otherwise

alarmed, it is curious to witness their attempt to make a start. They are terribly bad goers, and remind one of the clumsy individuals described by the sailors as 'a chap with a kink in his leg.' Instead of going forward, they spin round and round, like a 'merry-go-round' in a horse-pond. If our crippled friends had been wild fish, they would soon have been snapped up by their kind friends their brother fish, or by some hungry water beast or other, for there are plenty about. I have already hatched out a most curious specimen myself, viz., a trout with two heads, and one tail which serves for the two heads, and one umbilical bag. This double fish is alive and well. Mr. Ponder has sent me not only a similar specimen of a trout (also alive), but also a salmon with one tail and two bodies (a most desirable breed of fish in the eyes of the fishmonger, if we could only manage to cultivate them). He

also found amongst the young fish, a charr with four eyes, a trout with a body twisted like a bell-spring, a trout with a body as round as a ring, and many other deformed patients."

ANATOMY OF THE YOUNG FISH.

Not only are our young fish beautiful objects when viewed with the unassisted eye, but when placed on the stage of a microscope they afford one of the most beautiful sights ever beheld by the physiologist. The heart can be plainly seen, and its pulsations counted. The course of the blood can also be observed, and as an object illustrative of the circulation it eclipses any that has ever before been presented. The foot of a frog is pretty enough, but is no more to be compared to the young fish than a schoolboy daub to one of Sir Edwin Landseer's pictures.

Two points remained until lately undecided: in fact they had not hitherto been

observed, or at least not carefully so: these were, first, how the nourishment was conveyed from the umbilical bag into the system of the young fish; and, secondly, whether the incessant action of the pectoral fins in the young fish was voluntary or not. These points were solved, with the aid of the microscope, by Mr. Henry J. B. Hancock, F.C.S., F.Z.S., who discovered, after a minute dissection of the little strangers, that the motion of the fins was purely voluntary, and that the nutrition of the young fish was carried on as follows:—The umbilical vesicle consists of a double sac, or one bag within another, containing fatty matter. The outer sac is insensible, and only serves as a protection for the inner one, which is covered with a net-work of veins. The vesicle contains, besides the fatty matter, one or two globules of pure oil. It appears that a portion of the fatty contents of the bag is received by

absorption into the net-work of veins covering the inner sac, is by them conveyed with the blood into the large vein, which can be perceived with the naked eye bordering the front part of the vesicle; through this it proceeds to the heart, whence it is transferred to the liver, assimilated, and again returned to the heart for distribution by means of the arteries, and eventually to go through the same process again. This operation of nutrition will be better understood by reference to the wood engraving at the commencement of the book.

FINAL MANAGEMENT OF THE YOUNG FISH.

Of course, after the umbilical bag has been absorbed, there is more work for the pisciculturalist. He has now to feed his fish for a time, until they are strong enough to turn out. I cannot, in the limits of this little book, give instructions how this is to

be done, further than that the yelk of hard-boiled eggs, or powdered biscuits, are the most approved viands. Authorities differ much amongst themselves as to what age is the best for turning out the young fish to fight their own way in the world, some saying that it is better to keep them until they assume the smolt form; and others, that is better to turn them out at once, urging as a reason for this that when they are turned out very young they have to graduate through their difficulties and so learn to shift for themselves. This point I leave to be settled by my friends, Mr. Ponder, of Hampton, Messrs. Ashworth and Buist, and many other gentlemen who have, like them, made the science of pisciculture their study.

TRANSPORT OF OVA.

The reader will very likely say, how are we to get the eggs? We cannot expect to

find them in the puddle in front of the house, so as to have nothing to do but to carry them up into the room where our apparatus is. They must come from a distance. How are we to carry them? The plan adopted by the authorities at Huningue (the great French fish-hatching establishment) is as follows:—Into wide-mouthed bottles they put a layer of clean wet moss, then a layer of eggs, then more moss, and so on till the bottle is full, but there must be no pressure anywhere. The mouths are then covered with bladder, and holes pricked therein with a penknife. The bottles are then packed *upright* in a box, and stuffed down tight with dripping wet moss, the cover is put on and fastened down. The box is put inside another box, two or three inches larger in every direction, and filled up tight with wet moss. One precaution is necessary. The ova must not be sent any distance *before the*

eyes of the fish within are quite plainly perceptible; if they are, they will most certainly turn out good for nothing. We may add, that (all honour and praise to J. A. Youl, Esq.) a plan has been tried for sending out salmon ova to Australia, which has met with very promising success. The method alluded to is by freezing the ova, and sending them out in ice.

In order to show what is doing for the Thames, I give the number of fish which Mr. Ponder has had under operation this last season for the "Thames Angling Preservation Society," the fish, of course, will be placed in the Thames *pro bono publico.*

Rhine Salmon	15,500
English Trout	97,000
French Trout	4,800
Ombre Chevalier (Charr) . . .	4,000
Great Lake Trout	2,500
Salmon Trout	900
Total,	124,700

Now, young salmon can be turned into the Thames at the rate of four a penny, so that the 15,500 must have cost 16*l.* 2*s.* 11*d.* We will imagine their return at the end of two years and eight months, not one of them under 12 lbs.! which at 1*s.* per lb. (the lowest it ever is, now, alas!) will make each of them worth 12*s.* So that the fish which originally cost 16*l.* 2*s.* 11*d.* become in a short time, *without any further expense of any kind*, worth no less than 9300*l.*! thus returning 576 times the outlay—truly a noble speculation, if nothing better.

The operations at Huningue are carried on on an enormous scale, and also on a scale of most unparalleled liberality. For instance, out of 19,449,400 ova collected in the season 1861, no less than 16,244,050, after having been partially hatched for a period of two or three weeks, were forwarded in a sound state to upwards of 238 different places, to

63 French departments, and 11 foreign countries!

PERCH AND GOLD FISH.

Now a word to the Ladies. Let them not imagine that because fish-hatching requires so many hard figures and dry statistics, it is on that account only fitted for men of business and science to carry out. Not at all. By means of a small portable apparatus Ladies may hatch perch and fish in their drawing-rooms or conservatories; and what could be prettier than a nicely-constructed little apparatus half hidden by plants and flowers judiciously arranged, and supplied by a fountain whose pretty ripple produces an always acceptable music? What a godsend for conversation during the dreadful half-hour before the dinner party, or the five minutes', "airing" between the dances! Nothing is easier than to have one; and

when obtained, nothing can be easier to manage. Mr. King, of 190, Great Portland Street, the well-known dealer in aquaria, and their marine and freshwater inhabitants, supplies at a small cost, and in the best possible manner, fish-hatching apparatus of all sizes, from those fitted for a large establishment to the small ornamental ones for the drawing-room or conservatory. Whoever has water laid on in the house can have an apparatus, fountain and all, with very little trouble or expense. Mr. King supplies the rustic pottery troughs, which I strongly recommend. I hope, ere long, to see the science taken up far and wide by those whose leisure gives them far more opportunities of observation than are at the command of those even who have already stirred themselves in the matter from a scientific point of view. And let no one forget that the columns of the "Field" are ever open to those who would either

announce the result of their experiences, or seek from others the same aid.

I must now conclude this sketch, necessarily brief, of the process of fish hatching. Those who carry it out (may their name be legion!) I would again beg to refer to my book for directions on every point. And I shall be glad to answer any reasonable questions addressed to me.

"VIVE LA PISCICULTURE."

FRANK BUCKLAND.

156, ALBANY STREET, REGENT'S PARK, N.W.
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THE END.

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